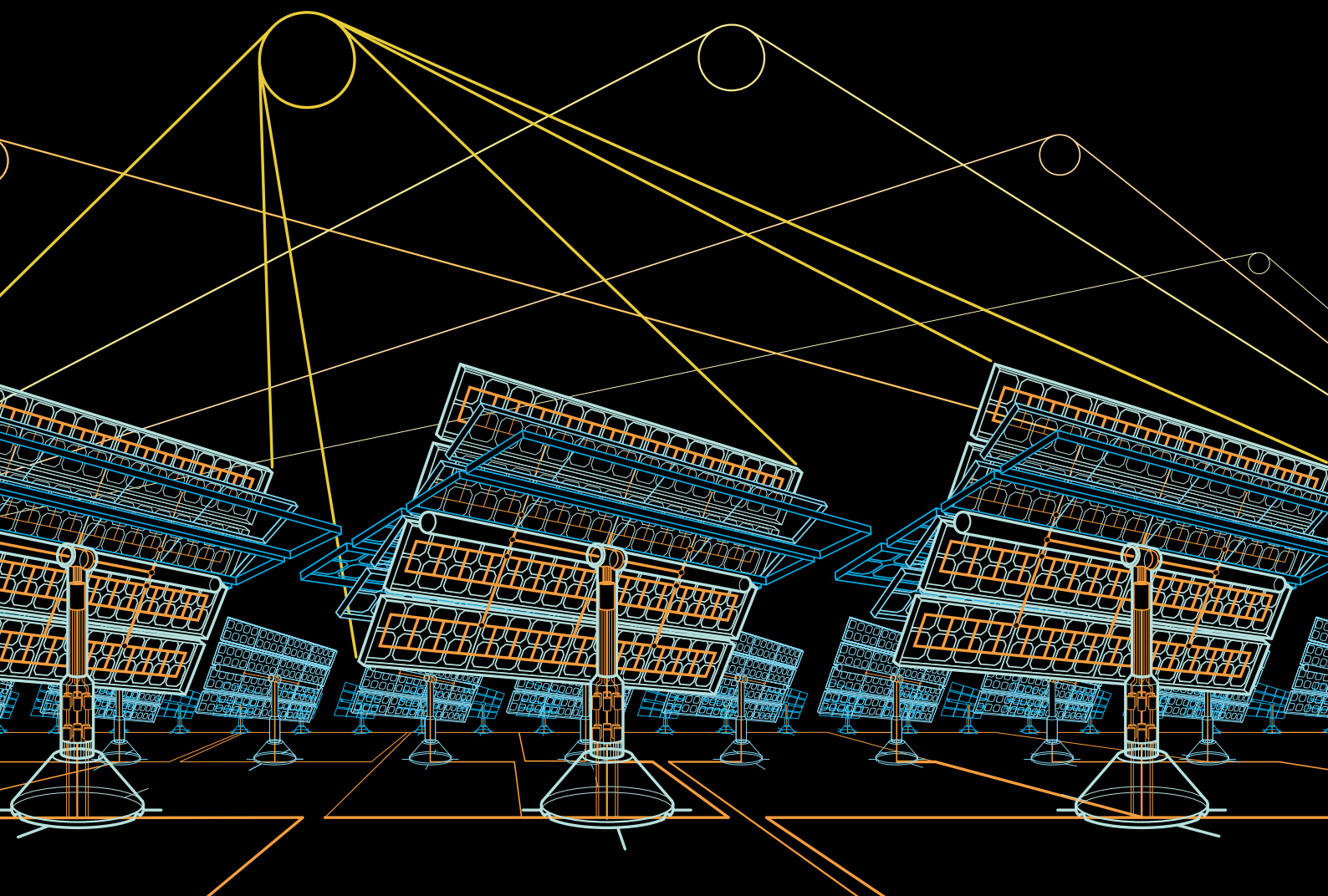


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APPLICATION NOTE AN014

# Protection of photovoltaic (PV) systems

## ESP AN014 for PV system power line protection



# Protection of photovoltaic (PV) systems

Increasingly considered as a viable and cost-effective source of renewable energy, PV systems now range from commercial and residential supplementary energy solutions, to large-scale power generation at solar parks etc.

Installation of PV arrays at roof level, and the siting of solar parks in open, exposed locations, makes PV systems highly susceptible to damage from partial lightning currents.

Partial lightning currents can enter the PV system following a direct lightning strike to the external lightning protection system (LPS), or via transient overvoltages from the wider electrical network.

## Protecting the PV system

**Effective protection against partial lightning currents can be achieved through installation of Surge Protective Devices (SPDs), on both the DC and AC sides of the DC-AC inverter.**

The mains power SPDs selected should conform to BS EN 61643-11, and be installed in line with the guidance provided in Technical Specification DD CLC/TS 50539-12:2010.

The appropriate SPD to protect each side of the inverter is dependent on whether the PV array is protected by an external LPS, and if so, whether the minimum separation distance (to BS EN 62305-3) between the LPS and the metallic parts of the PV array has been kept

## Installation on the DC side of the inverter

An SPD specifically designed for use on the DC side of a PV system (location 1 in Figures 1 & 2) should be installed.

The number of SPDs required is based on the distance between the PV array and inverter:

- If the distance between the PV array and inverter is less than 10 m, a single SPD installed as close as possible to the inverter, should suffice
- If the distance between PV array and inverter is greater than 10 m, two SPDs should be installed, one close to the inverter and the other close to the PV array

The minimum Type of SPD is defined in Table 1.

The Furse ESP combined Type 1+2 SPDs for PV systems **ESP DC550/12.5/PV** and **ESP DC1000/12.5/PV** - are suitable for this purpose, providing protection against partial lightning currents, for Lightning Protection Zone (LPZ) boundaries LPZ 0<sub>A</sub> to LPZ 2.

## Installation on the AC side of the inverter

A lightning current SPD for protecting AC mains power supplies should be installed on the AC side of the inverter, dependent of the state of the external LPS (see Table 1).

The SPD should be positioned as close as possible to the origin of the AC supply (location 3), usually the mains distribution board (MDB), unless the distance between inverter and MDB is greater than 10 m.

Where this is the case, two SPDs should be installed - one close to the inverter (location 2) and the other close to the MDB (location 3).

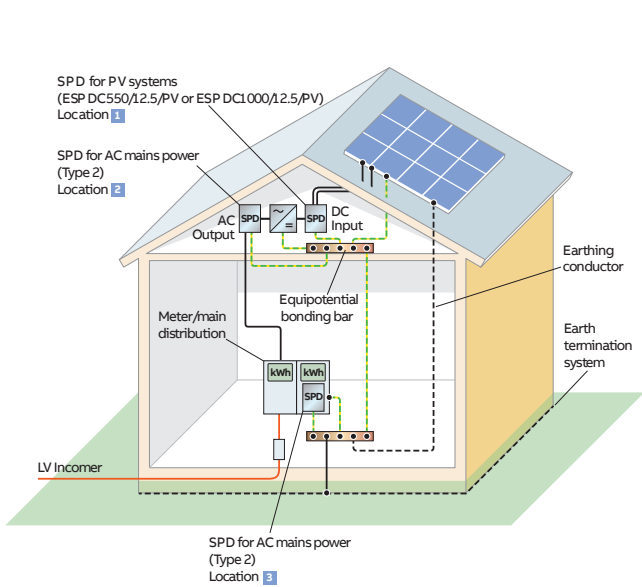
A Furse ESP combined mains power protector such as the ESP D1 Series or ESP M1 Series, is suitable at locations 2 & 3. As combined Type 1+2+3 SPDs, these units deliver low let-through voltage with full mode protection between all sets of conductors, for optimum surge protective performance.

The Class of LPS (i.e. the Lightning Protection Level (LPL) offered), and the metallic services connected to the structure further determine the appropriate Furse SPD to be installed (see Table 2).

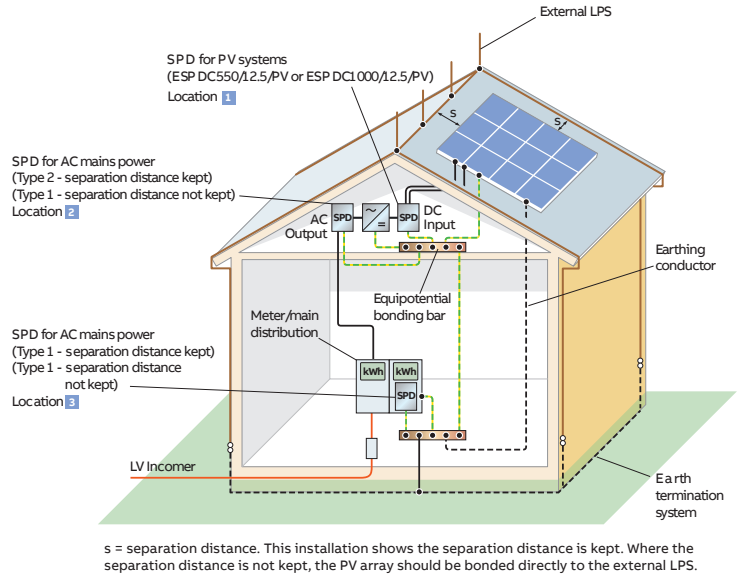
**Table 1: SPD Type according to external LPS configuration - see also Figures 1 and 2**

External LPS status	Minimum SPD Type required*		AC side of inverter
	DC side, distance PV array to inverter		
	< 10 m	> 10 m	
No external LPS	Type 2 SPD (PV)	Type 2 SPD (PV)	Type 2 SPD (mains)
External LPS (separation distance kept)	Type 2 SPD (PV)	Type 2 SPD (PV)	Type 2 SPD (mains) Type 1 SPD (mains)
External LPS (separation distance not kept)	Type 2 SPD (PV)	Type 1 SPD (PV)	Type 1 SPD (mains)

\* Furse ESP combined Type 1+2 SPDs for PV systems and Type 1+2+3 mains voltage SPDs are suitable for installation at applicable locations in the PV system and offer enhanced performance over and above Type 1 or Type 2 SPDs.

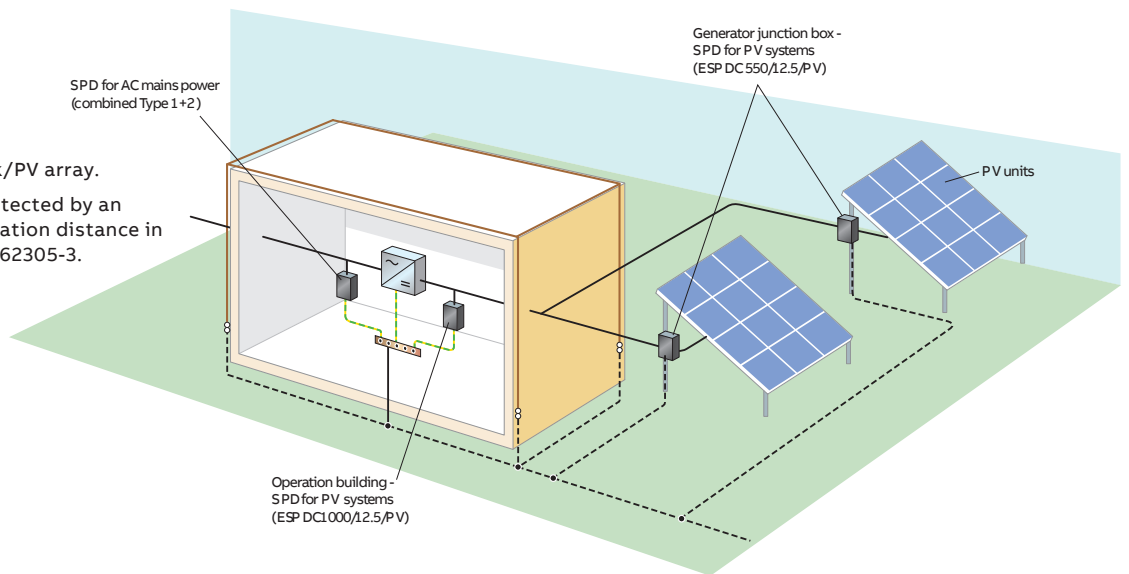


**Figure 1 :**  
**Roof mounted PV array,**  
**no external LPS**



**Figure 2 :**  
**Roof mounted PV array,**  
**external LPS**

**Figure 3 :**  
**Protection of solar park/PV array.**  
 PV arrays should be protected by an external LPS with separation distance in accordance with BS EN 62305-3.



**Table 2: AC protector requirement based on Class of LPS/connected metallic services**

Installation configuration	SPD (for 3 Phase 415 Vac supplies)
No external LPS, underground mains supply	ESP 415 D1 or ESP 415 M1
No external LPS, exposed overhead mains supply	ESP 415 /III/ TNS or ESP 415 M2
External LPS, multiple connected metallic services	ESP 415 D1 or ESP 415 M1
External LPS, unknown connected metallic services	ESP 415 /I/ TNS or ESP 415 M4 for LPS to LPL I & II ESP 415 /III/ TNS or ESP 415 M2 for LPS to LPL III & IV

Note: All the Furse ESP Protectors stated above provide at least combined Type 1+2 protection against partial lightning currents (LPZ boundaries LPZ 0B to LPZ 2 minimum), suitable for installation on the AC side of a PV inverter.

**Important**

This Application Note refers only to protecting PV systems from partial lightning currents.

For full protection of electronic systems, installation of SPDs to protect all incoming and outgoing services (mains power and data/telecoms lines) needs to be assessed in line with BS EN 62305. Please contact us for further information.

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